Lake Tahoe TMDL

Science Objectives

- What are sources and relative contributions of "contaminants" causing clarity decline?
- How much of a reduction is needed to achieve the desired conditions?

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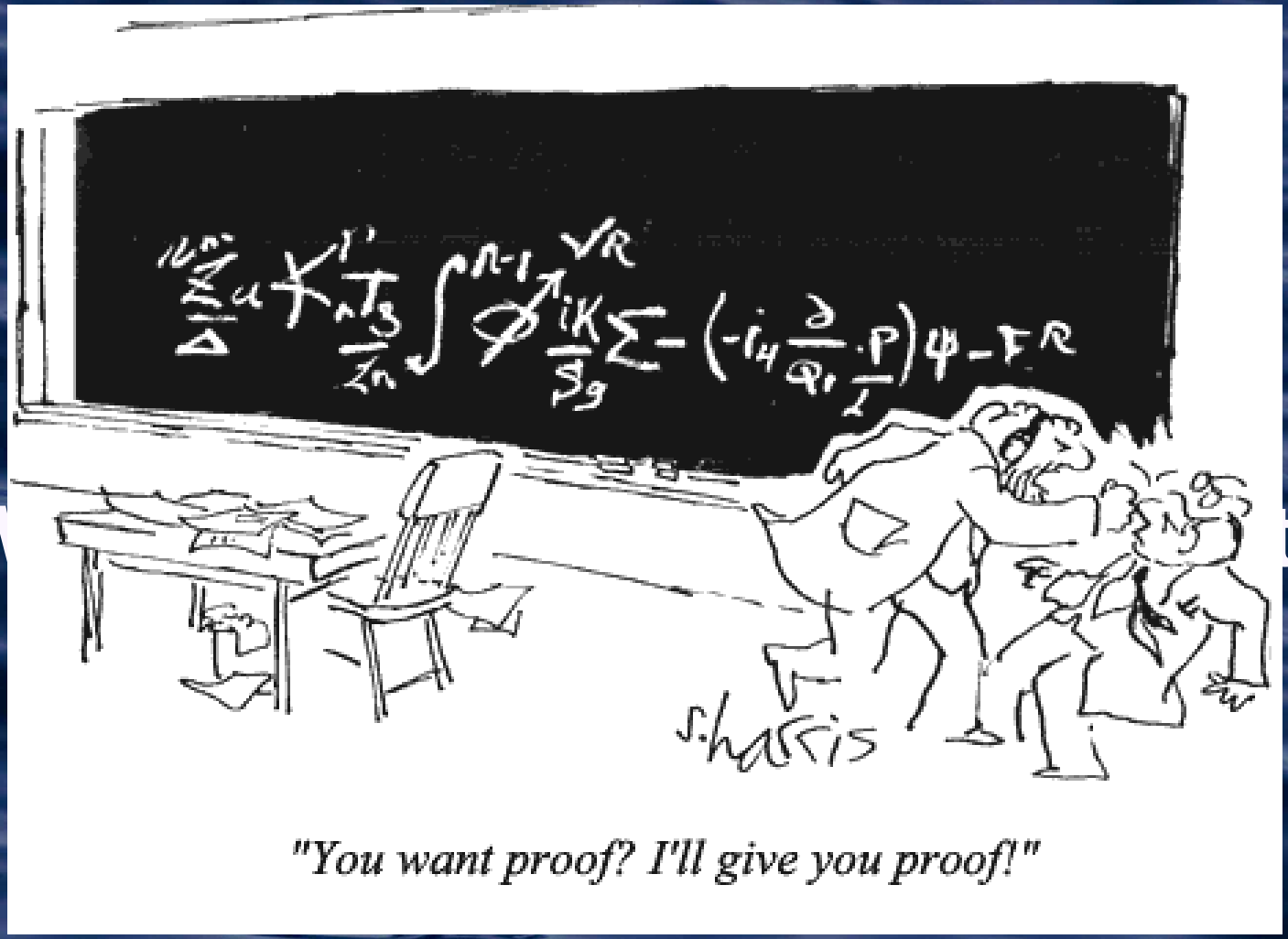

"You want proof? I'll give you proof!"

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The Clarity Model History

1978 – DYRESM
1996 – DLM-WQ
1997 – INAUGURAL TAHOE SUMMIT
EPA WATERSHED GRANT
2000 – FIRST PARTICLE SIZE DATA
2002 – TMDL SCIENCE PROGRAM FUNDED MODELING/SCIENCE
2004 – CLARITY MODEL PEER REVIEW
2006 – REFINEMENT/CALIBRATION/VALIDATION
2007 – COMMENCING USE OF "FINAL" MODEL

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CLARITY MODEL

A PROCESS-BASED NUMERICAL MODEL

SEVERAL MODELS COMBINED INTO ONE:
- HYDRODYNAMIC/THERMODYNAMIC MODEL
- WATER QUALITY (ECOLOGICAL) MODEL
- PARTICLE FATE MODEL
- OPTICAL MODEL

IN ADDITION, IT HAS "INPUTS" FROM OTHER MODELS
- WATERSHED MODEL
- METEOROLOGY MODEL
- ATMOSPHERIC MODEL

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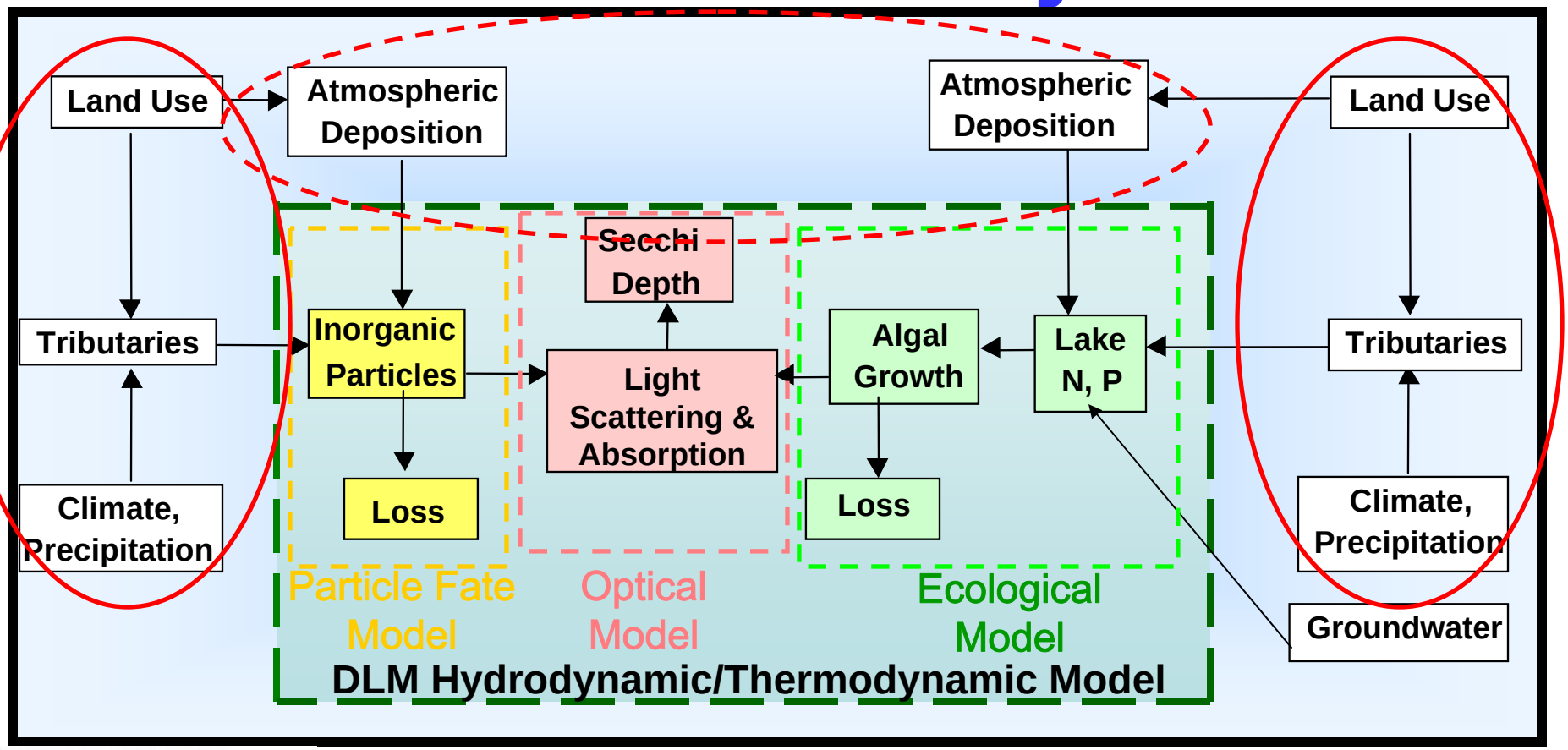
Lake Tahoe Clarity Model



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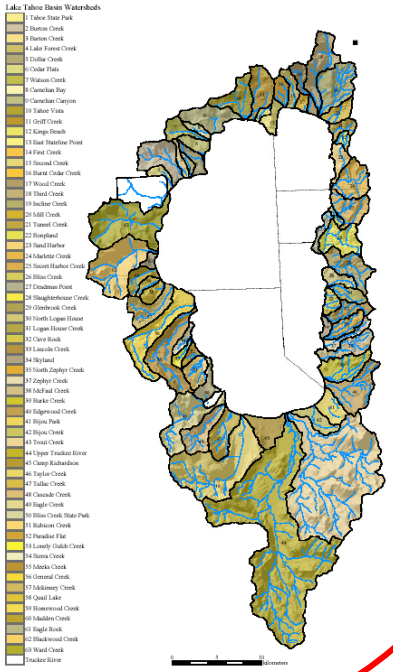
INPUT VARIABLES

CLIMATE

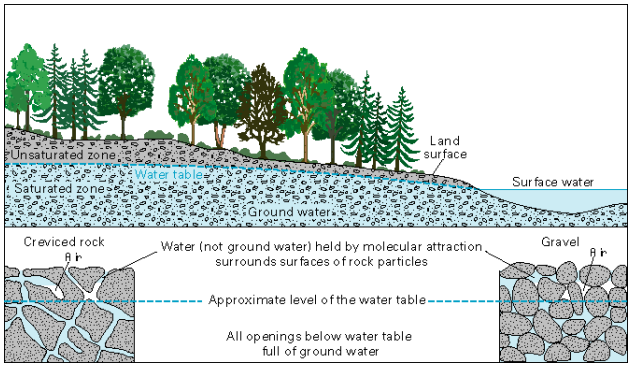
OUTFLOW

INFLOW – Q, N, P, PSD



BATHYMETRY

GROUNDWATER – Q, N, P



ATMOSPHERIC – N, P, PSD

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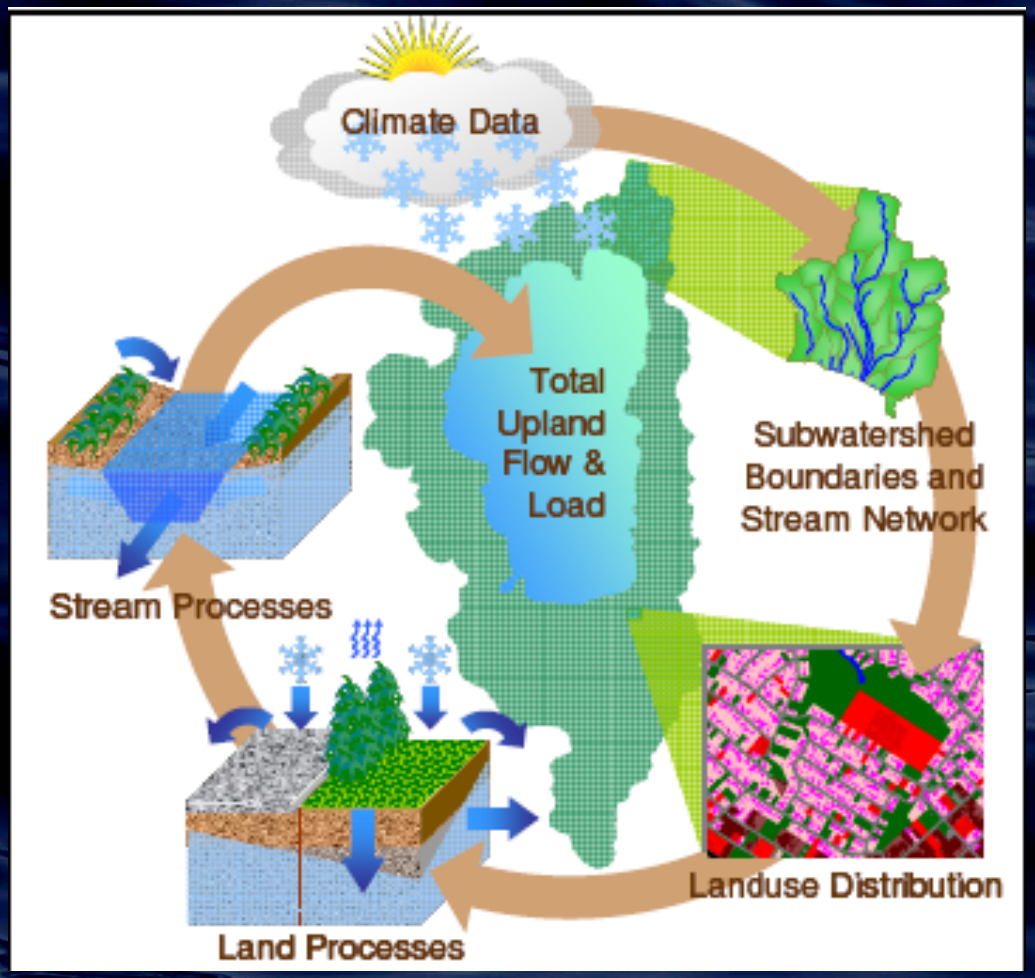
Tetra Tech Watershed Model



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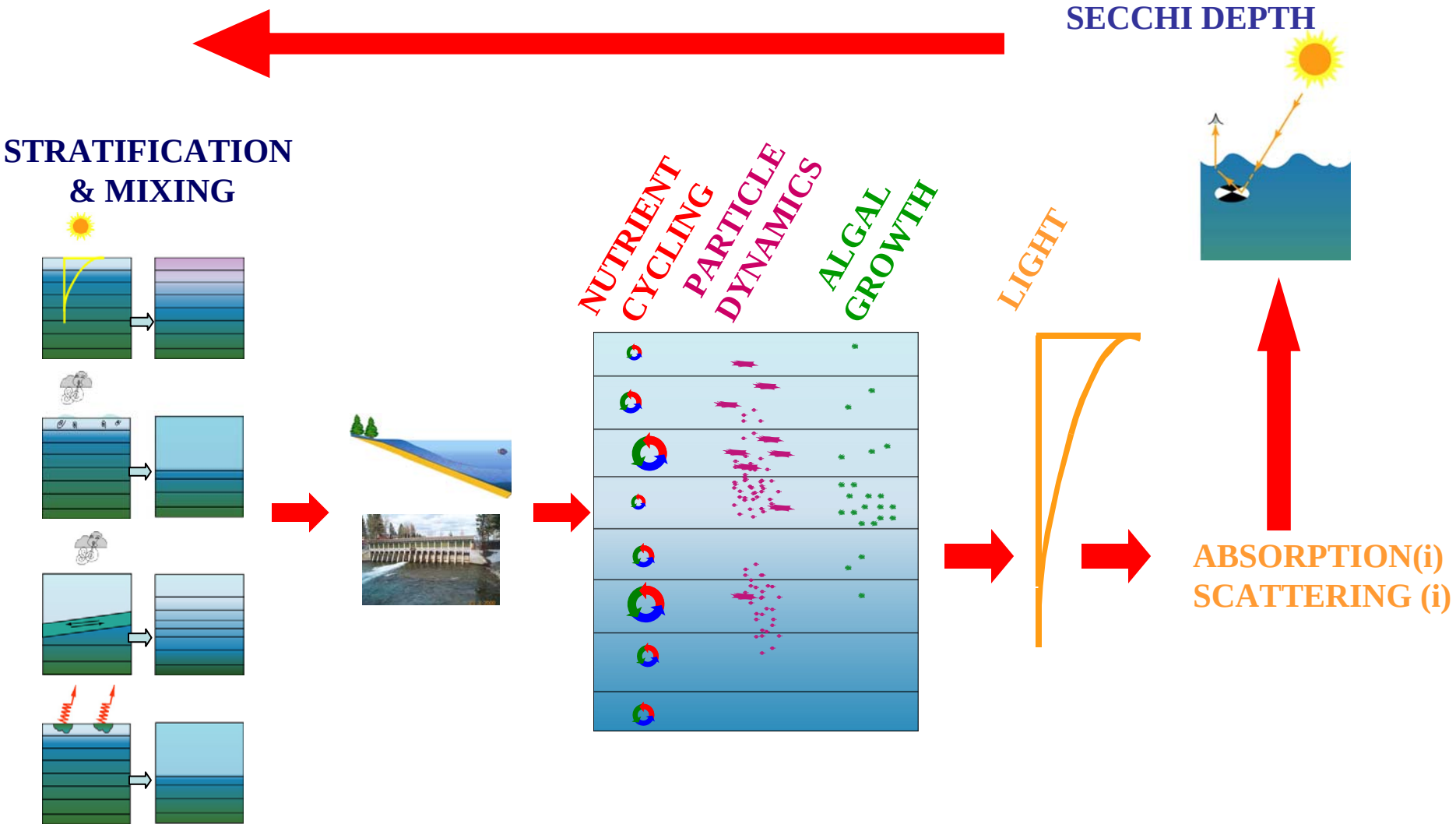
Clarity Model



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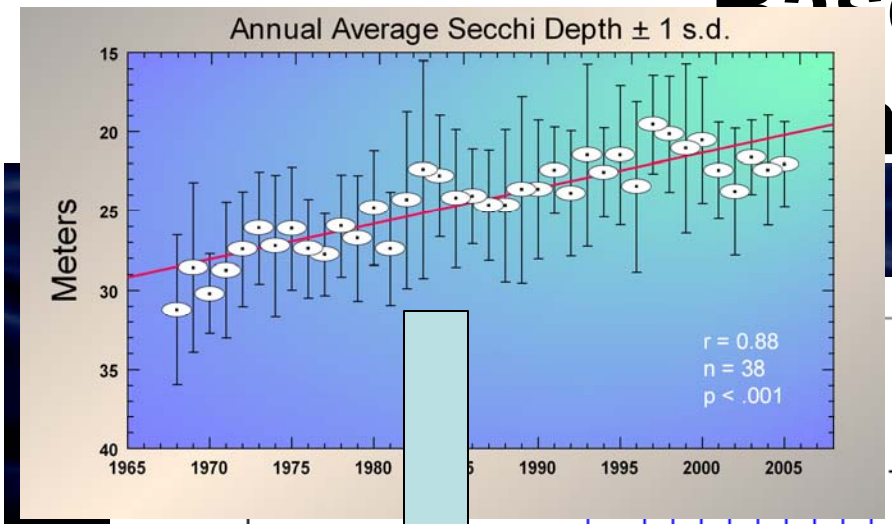
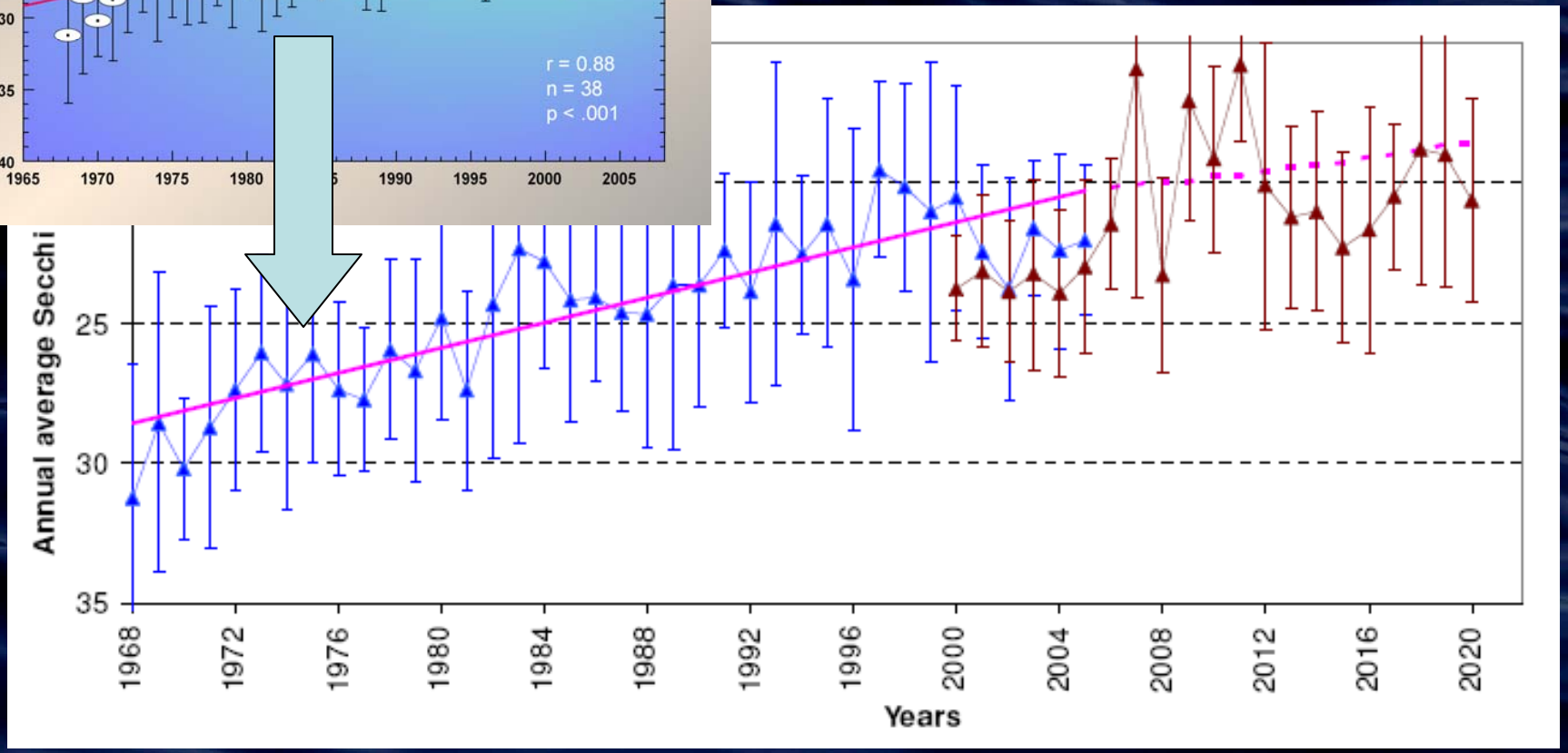
Base Case
in an Unchanging World





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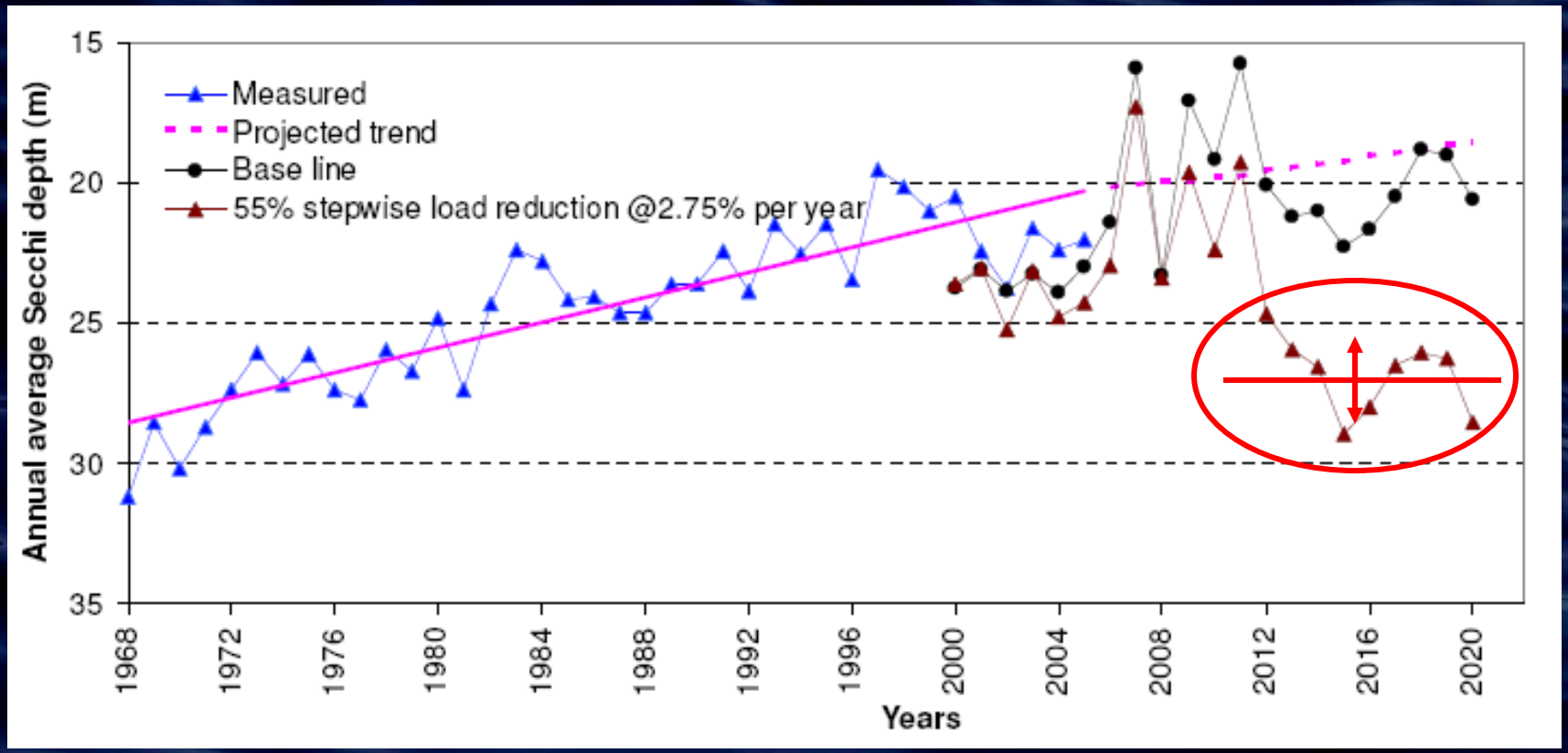
Test Case 1 – 55% Load Reduction
All Sources, All loads, 20 year Phase-in



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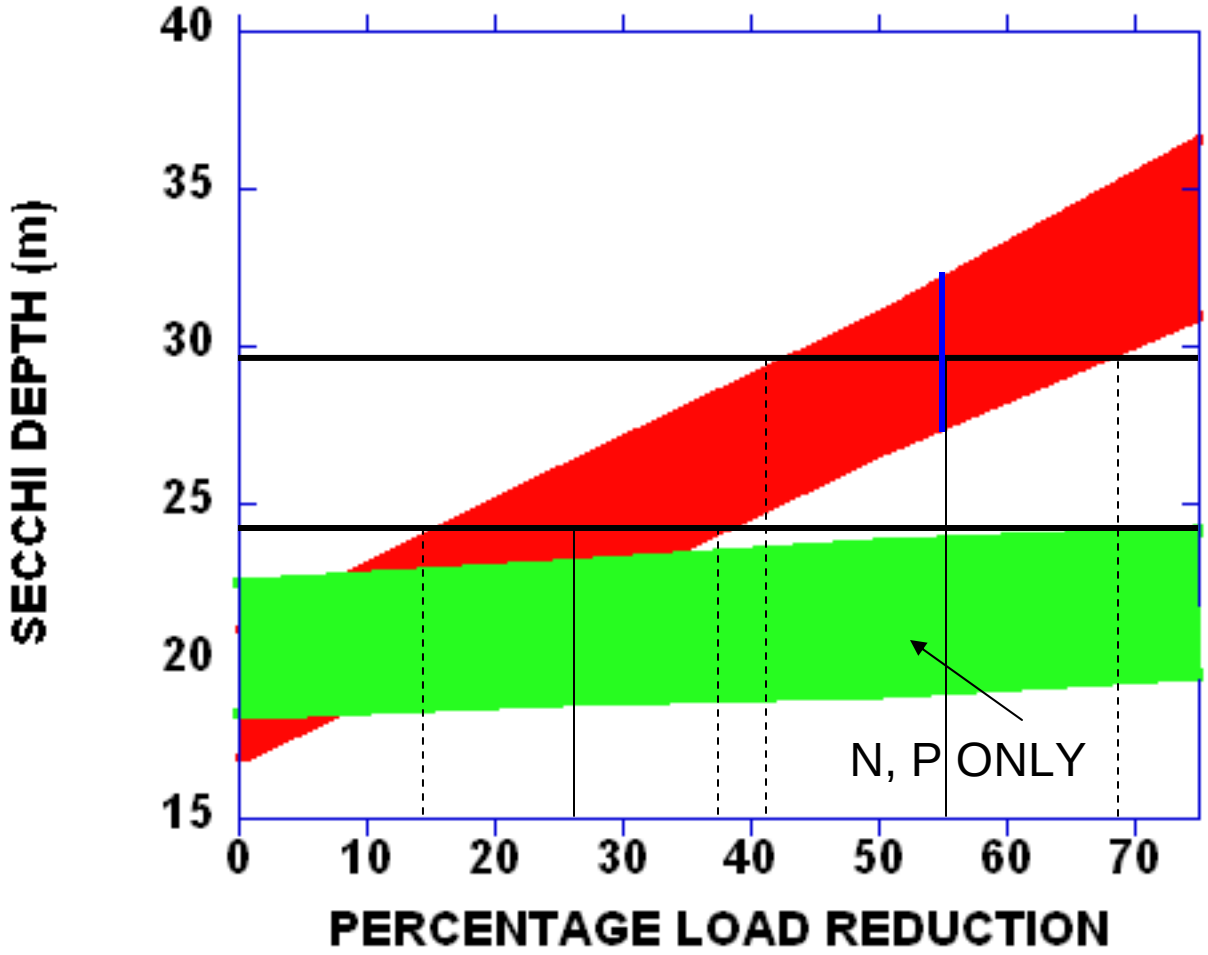
Combined Results
All Sources, All loads, 20 year Phase-in



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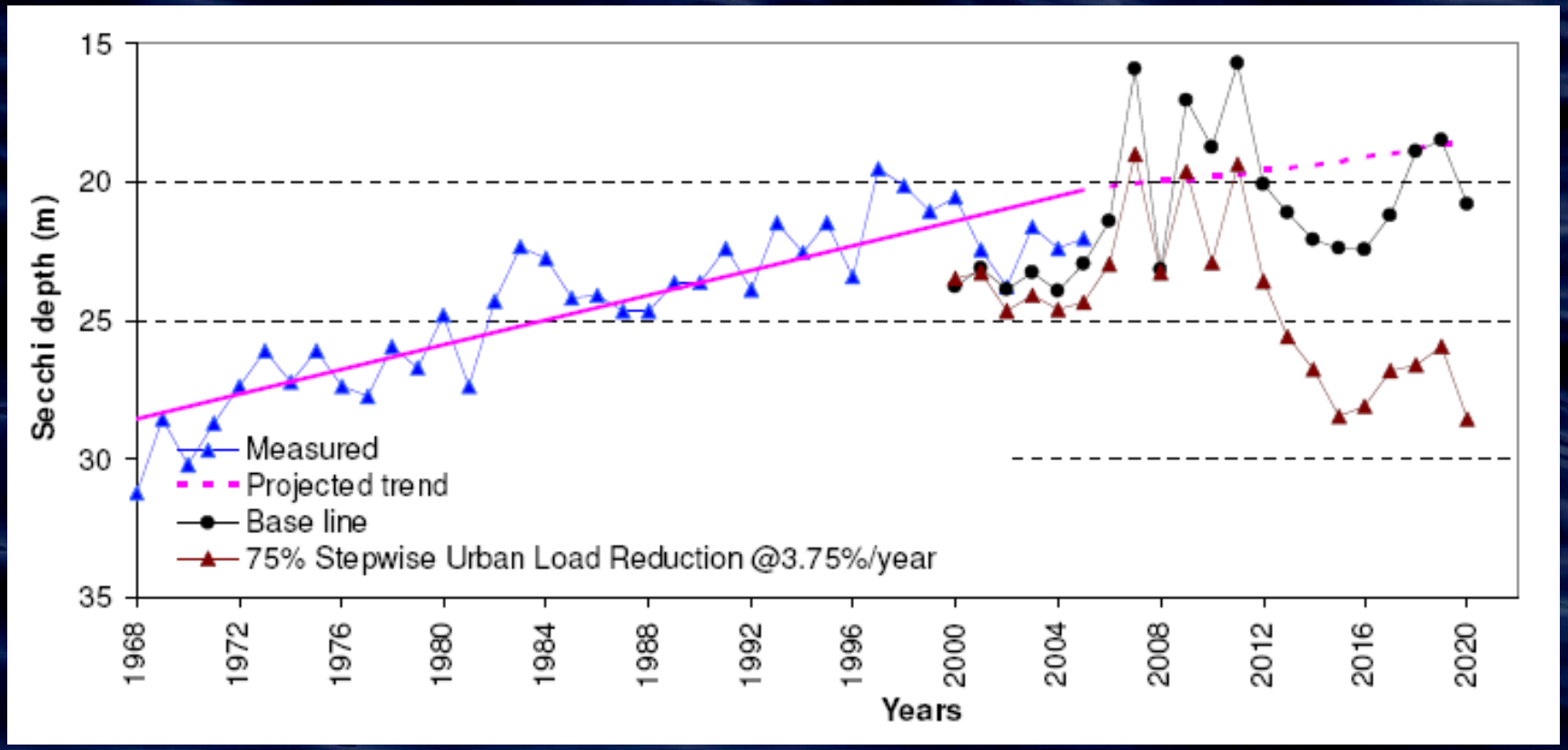
Test Case 2 – 75% Load Reduction

Urban Sources, All loads, 20 year Phase-in



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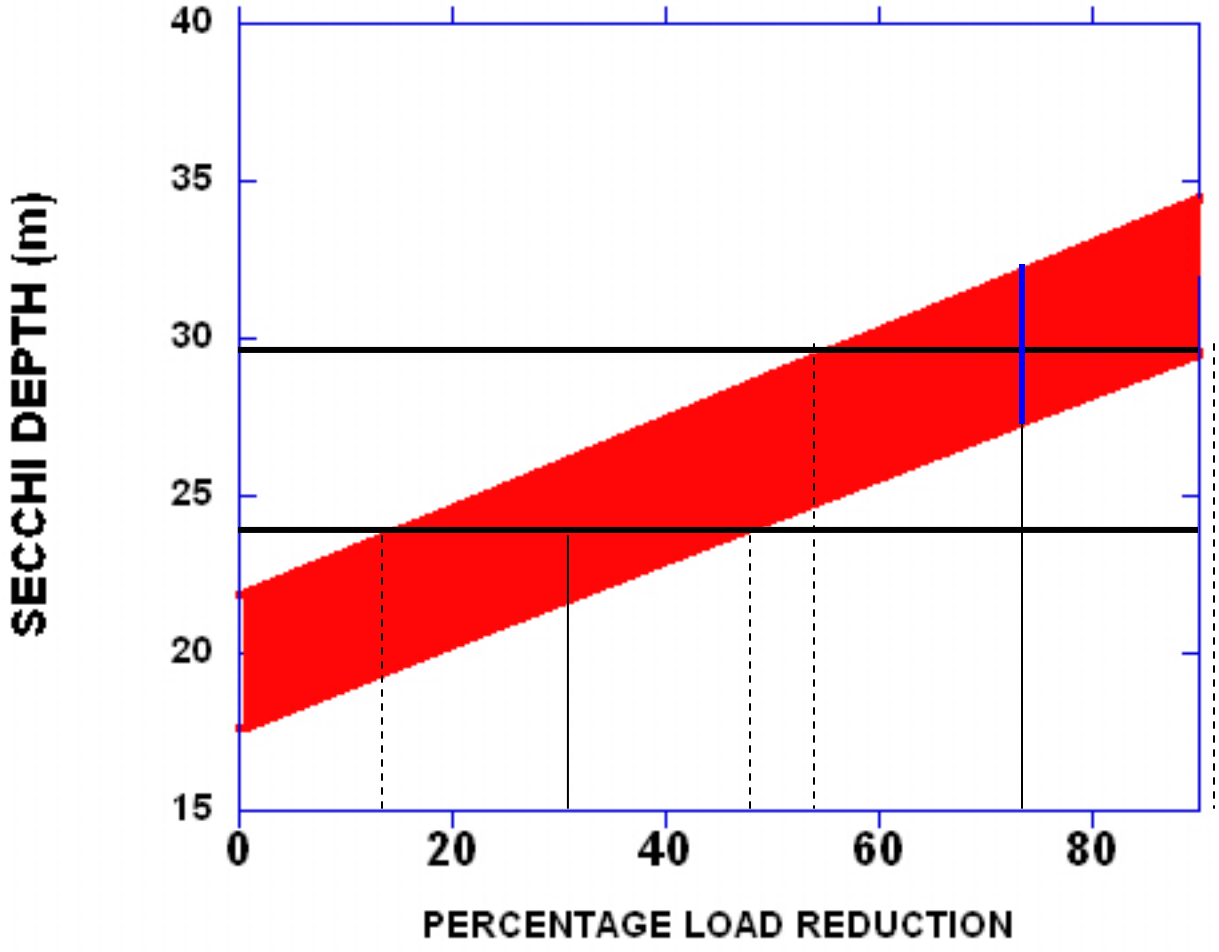
Combined Results
Urban Sources, All loads, 20 year Phase-in



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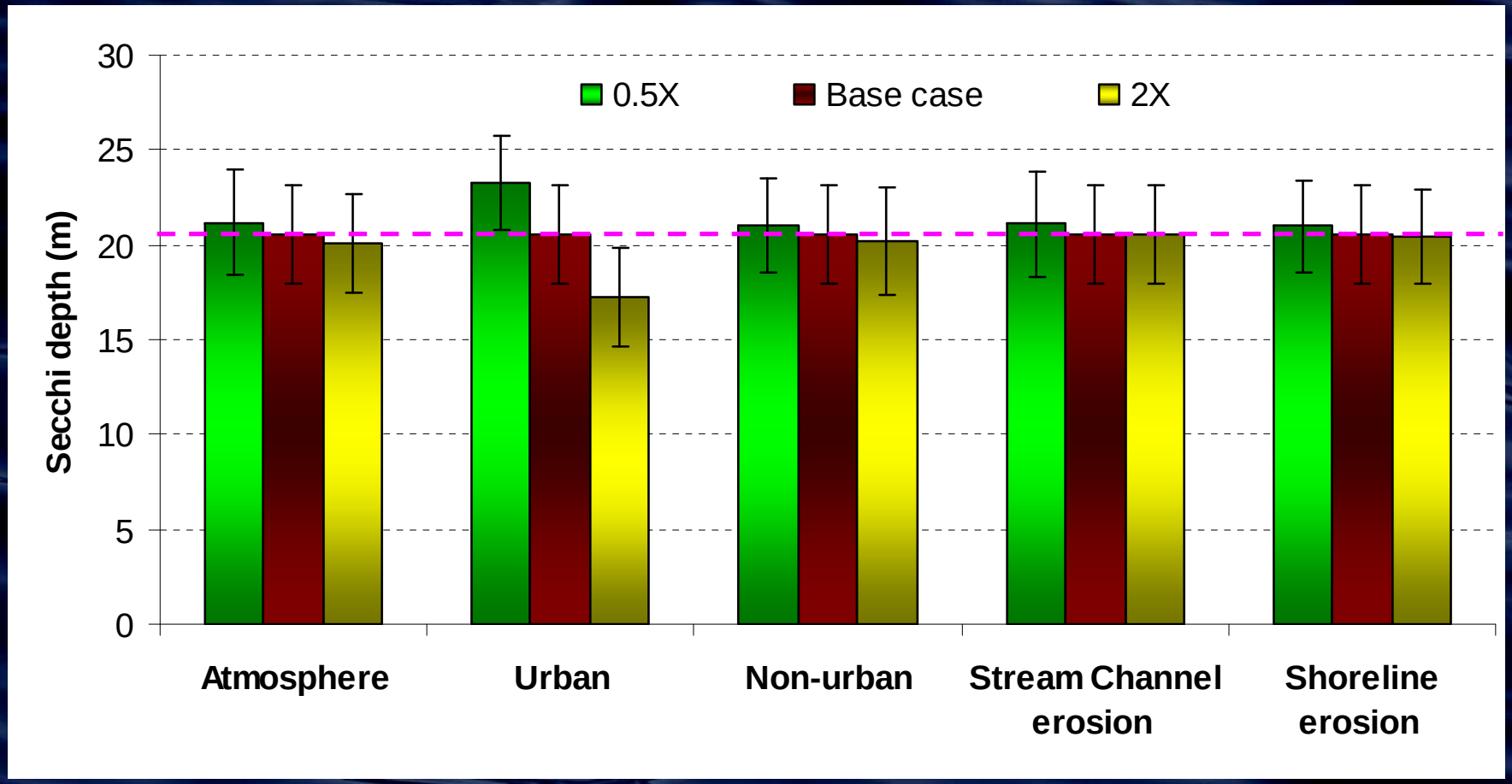
Sensitivity Analysis
Loads

Particle load has largest impact on secchi depth



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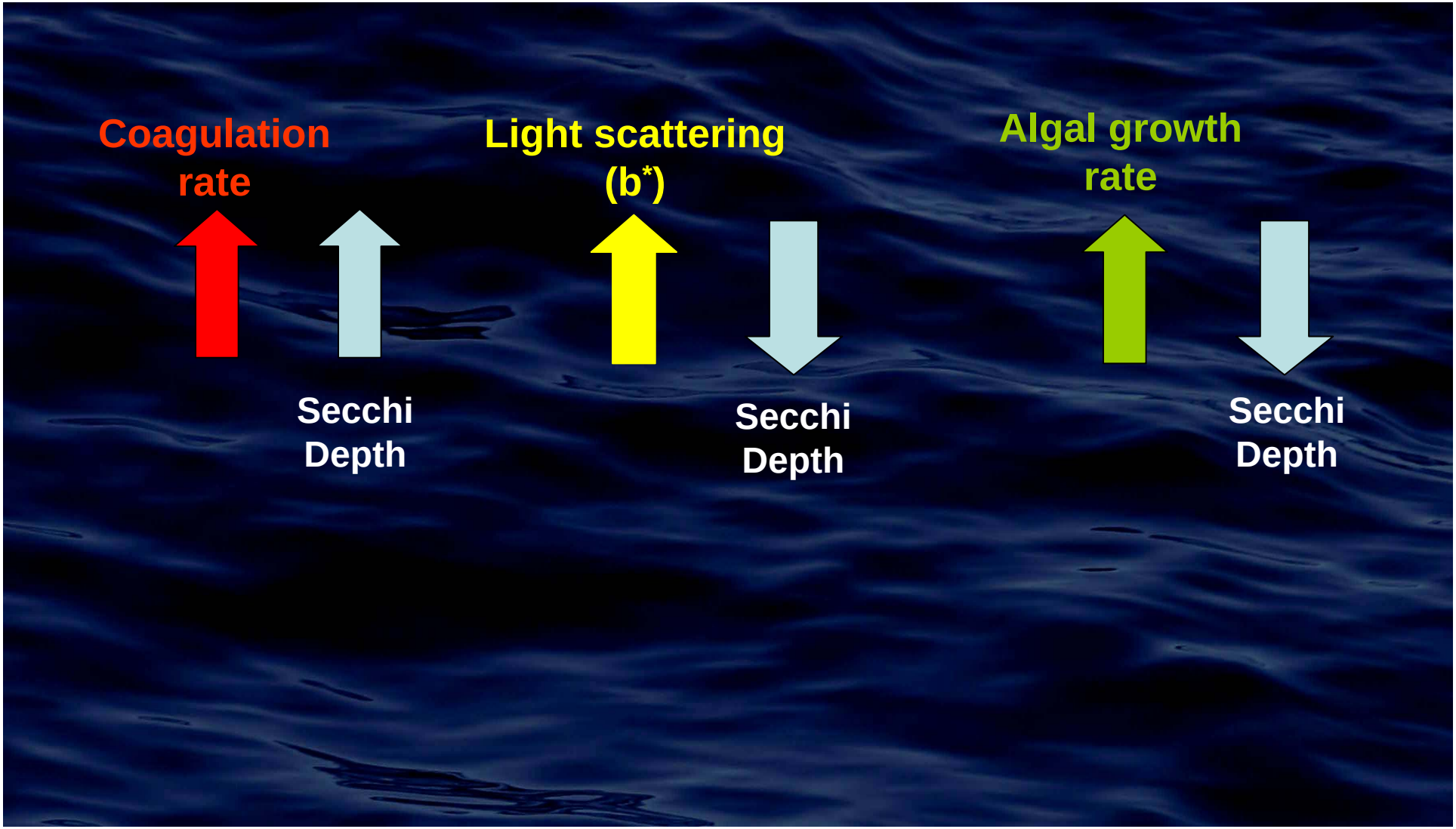
0.5X = half TMDL estimate
2X = double TMDL estimate

Sensitivity Analysis
Model Parameters



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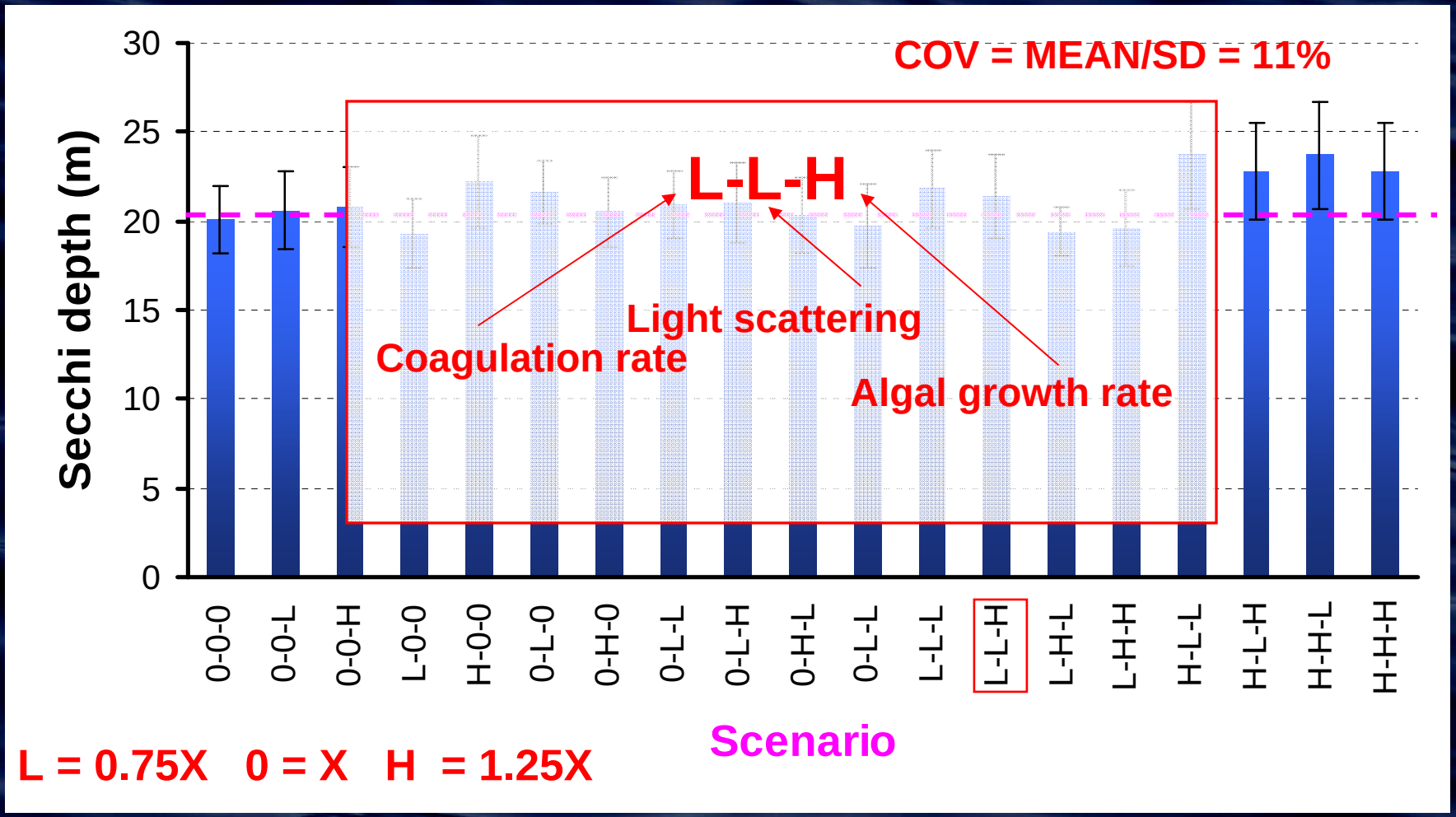
Sensitivity Analysis
Model Parameters



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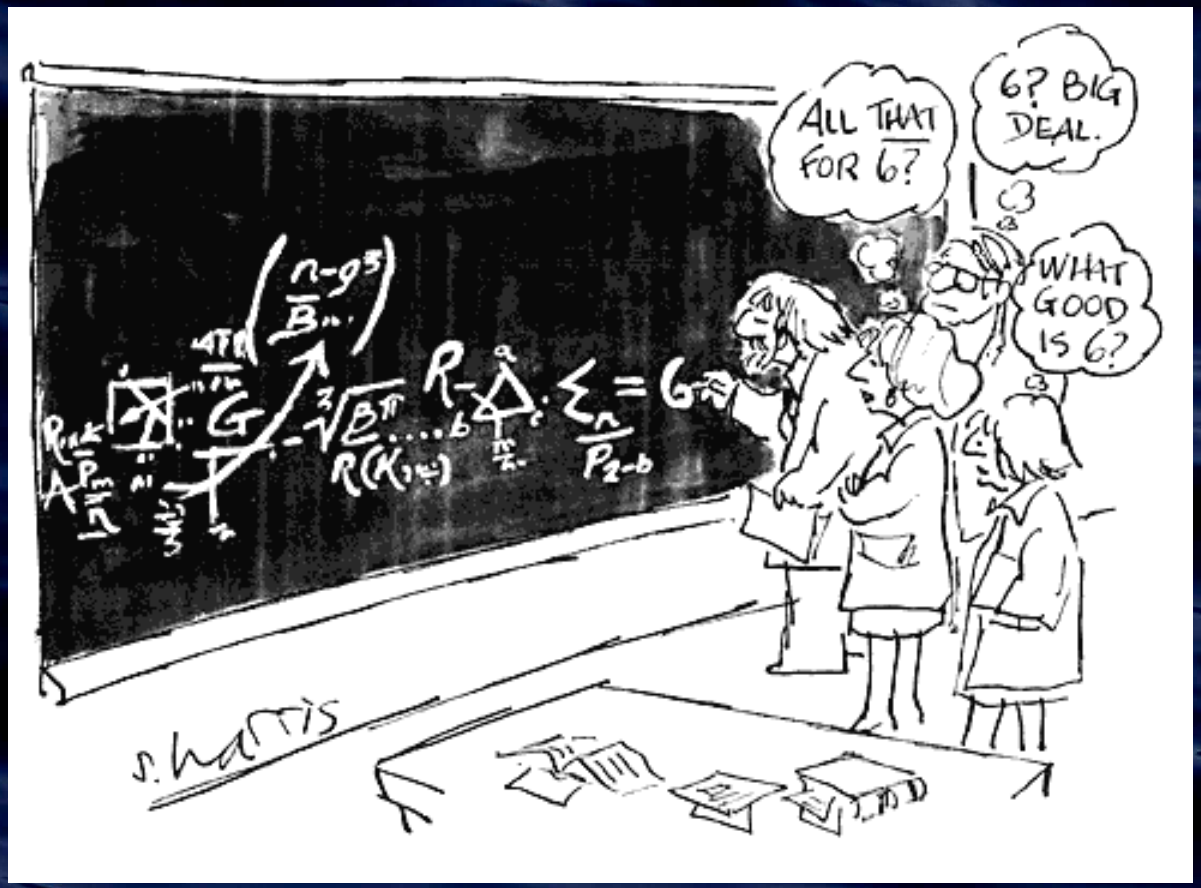
WHAT MAKES US THINK THE MODEL IS CORRECT?



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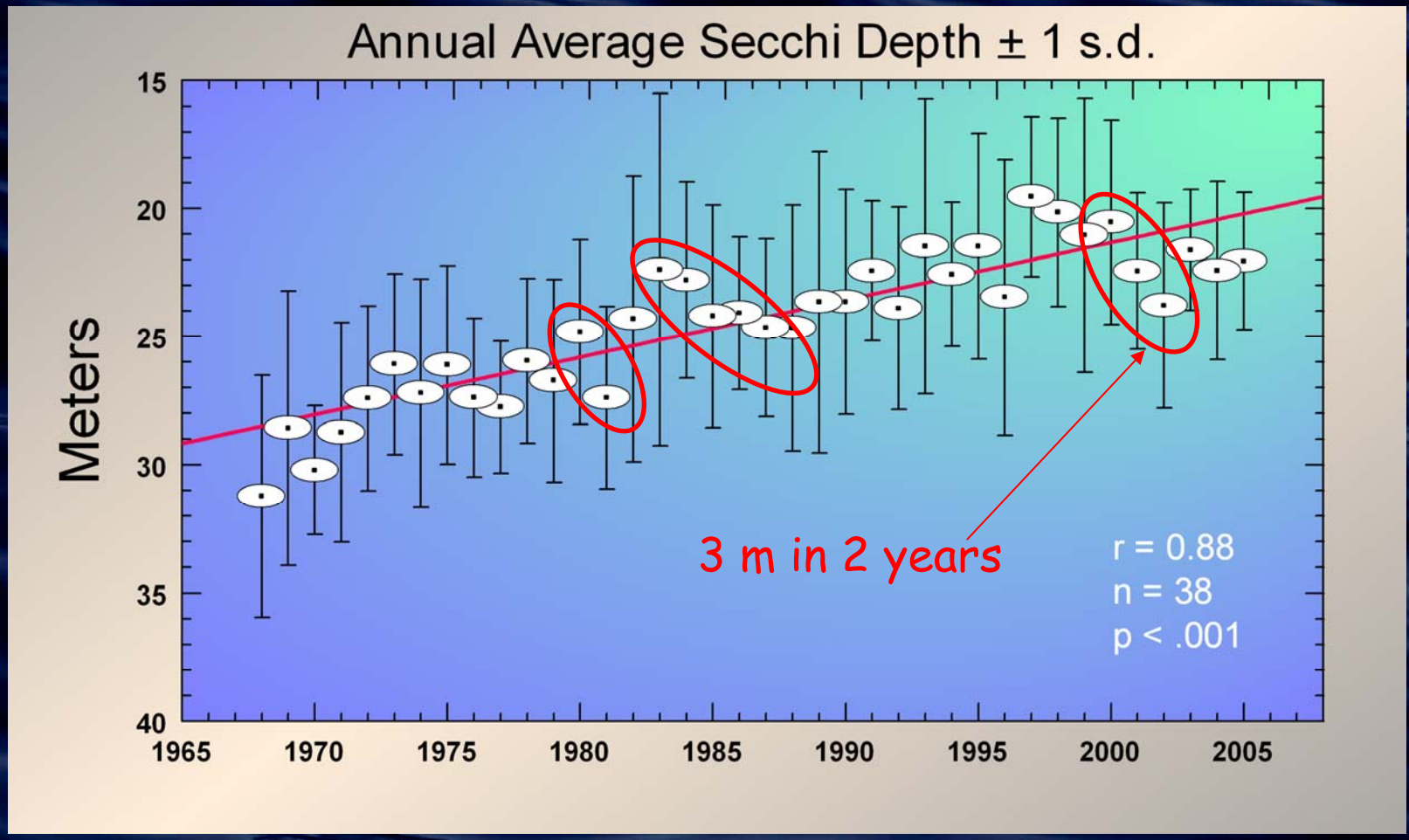
LOOK AT THE RECORD



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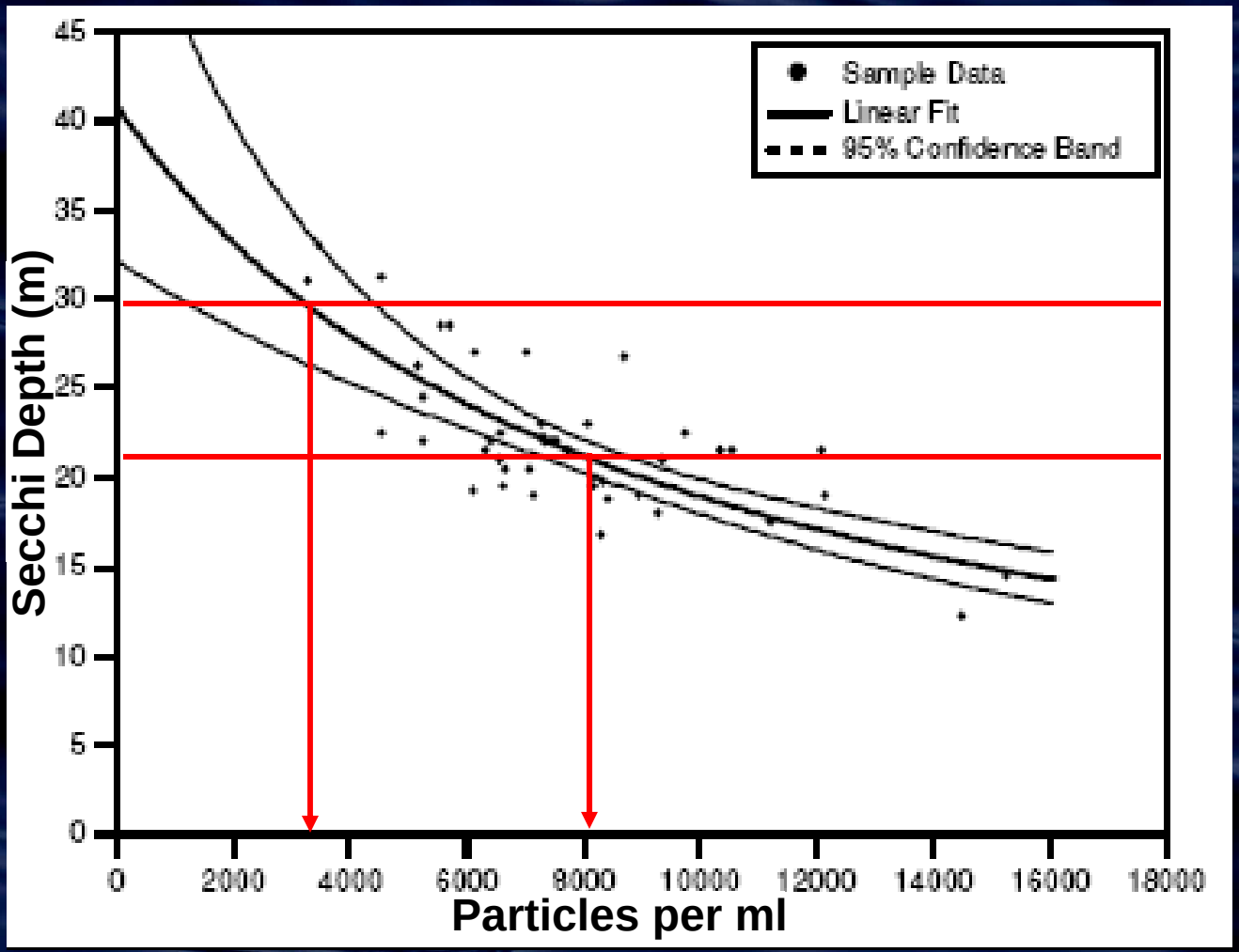
STILL NOT CONVINCED?



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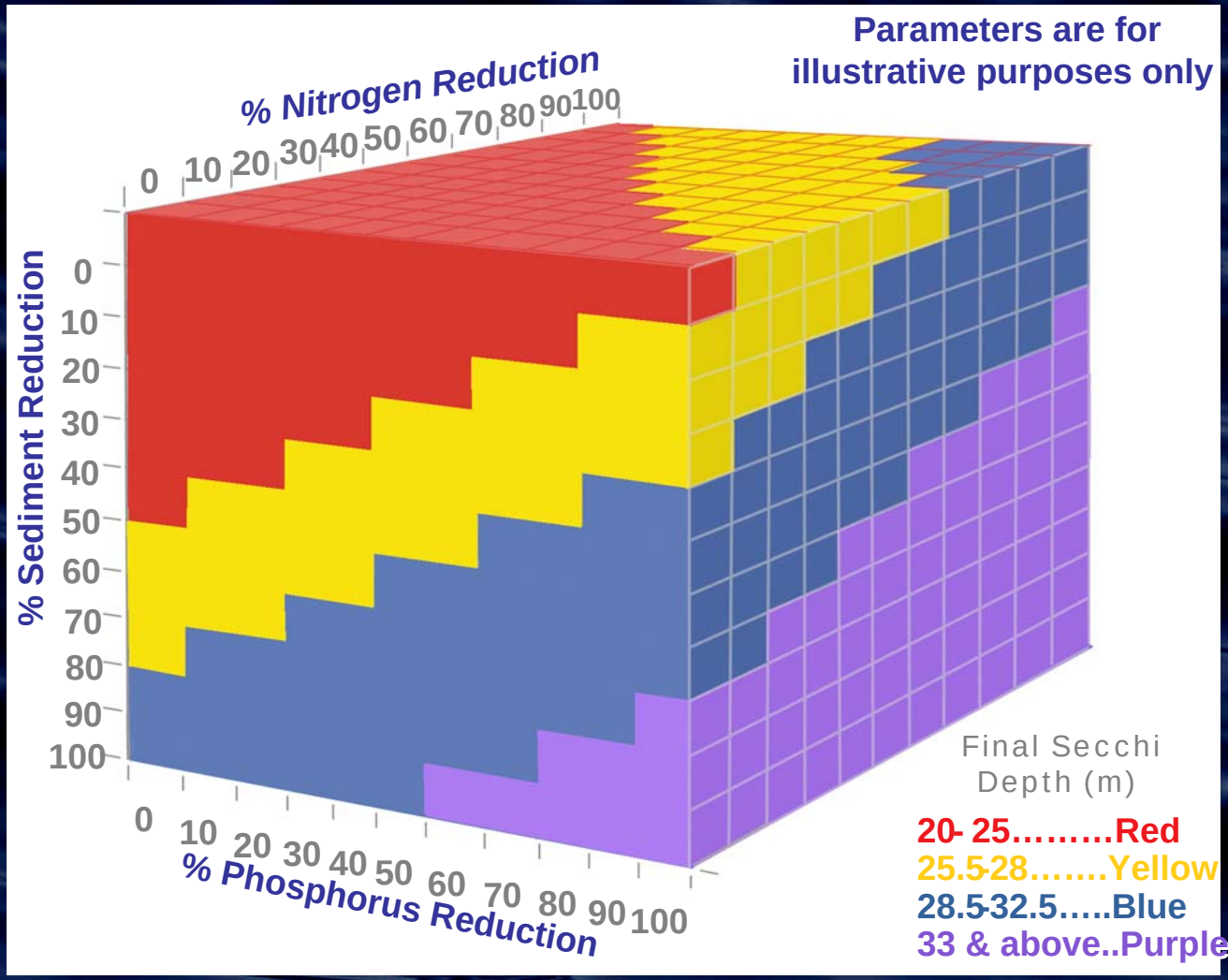
There are a multitude of ways to achieve a specific clarity target



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CONCLUSIONS

- Process-based model – allows examination of the entire range of management, climate, disaster, growth etc. scenarios
- Built on an established and peer reviewed framework
- Particles dominate midlake clarity (nutrients secondary) – confirmed by data
- Urban areas dominant source of particles – confirmed by data
- Model results insensitive to uncertainties
- Model predicted level of pollutant load reduction to achieve clarity target is confirmed by data
- There are countless ways in which the desired load reductions can be achieved. The model can test them. The stakeholders must decide.

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THANK YOU!

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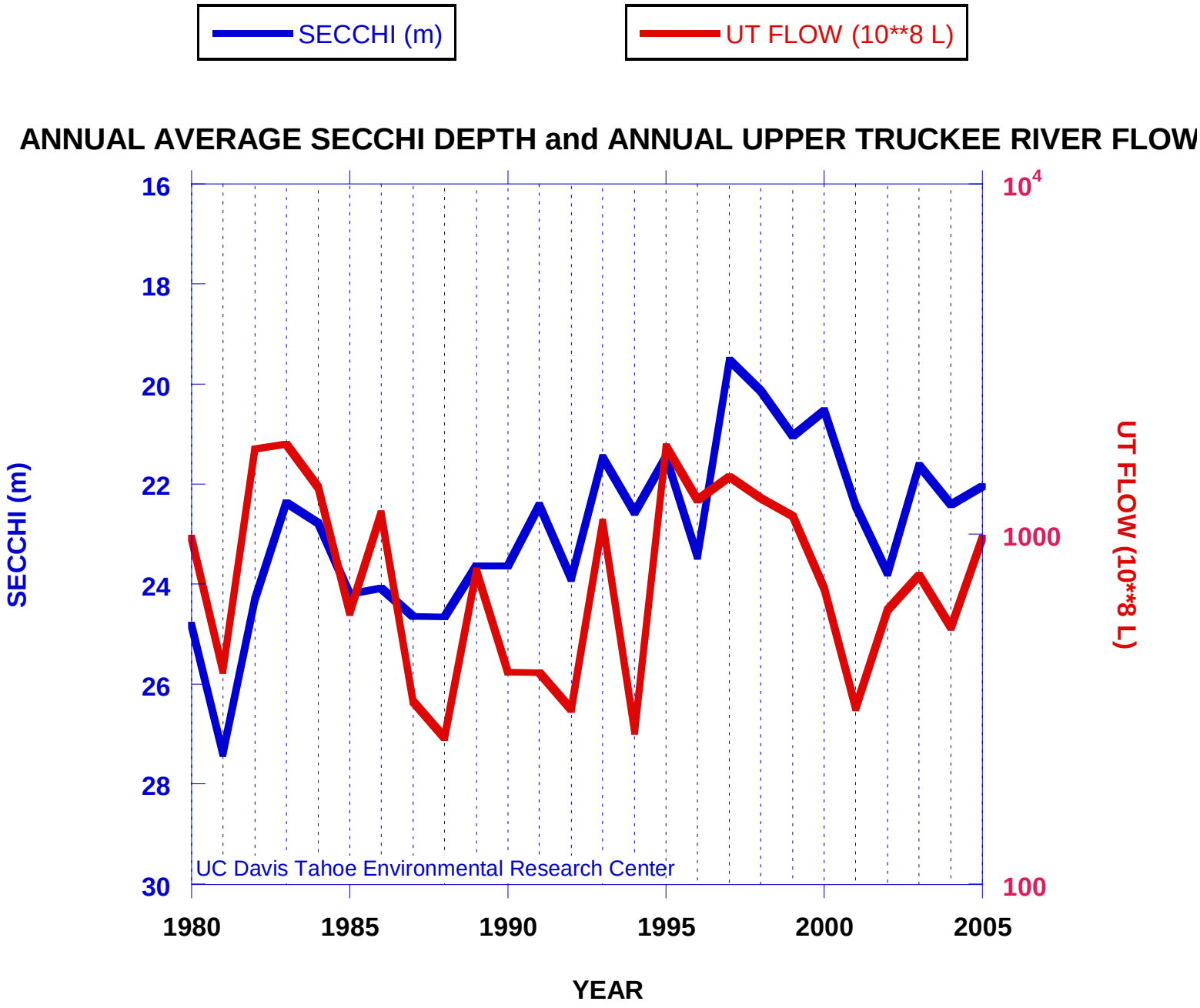
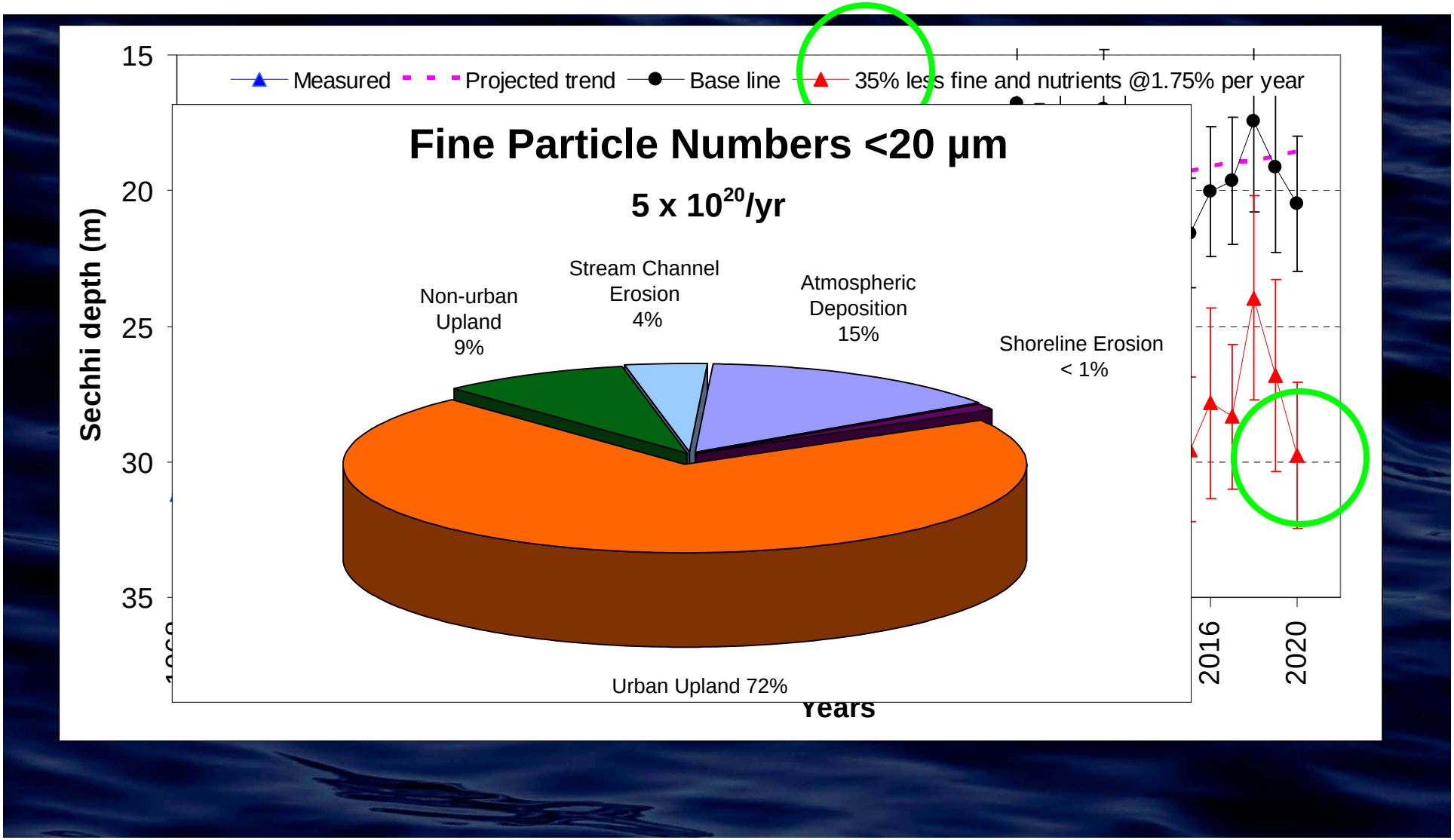
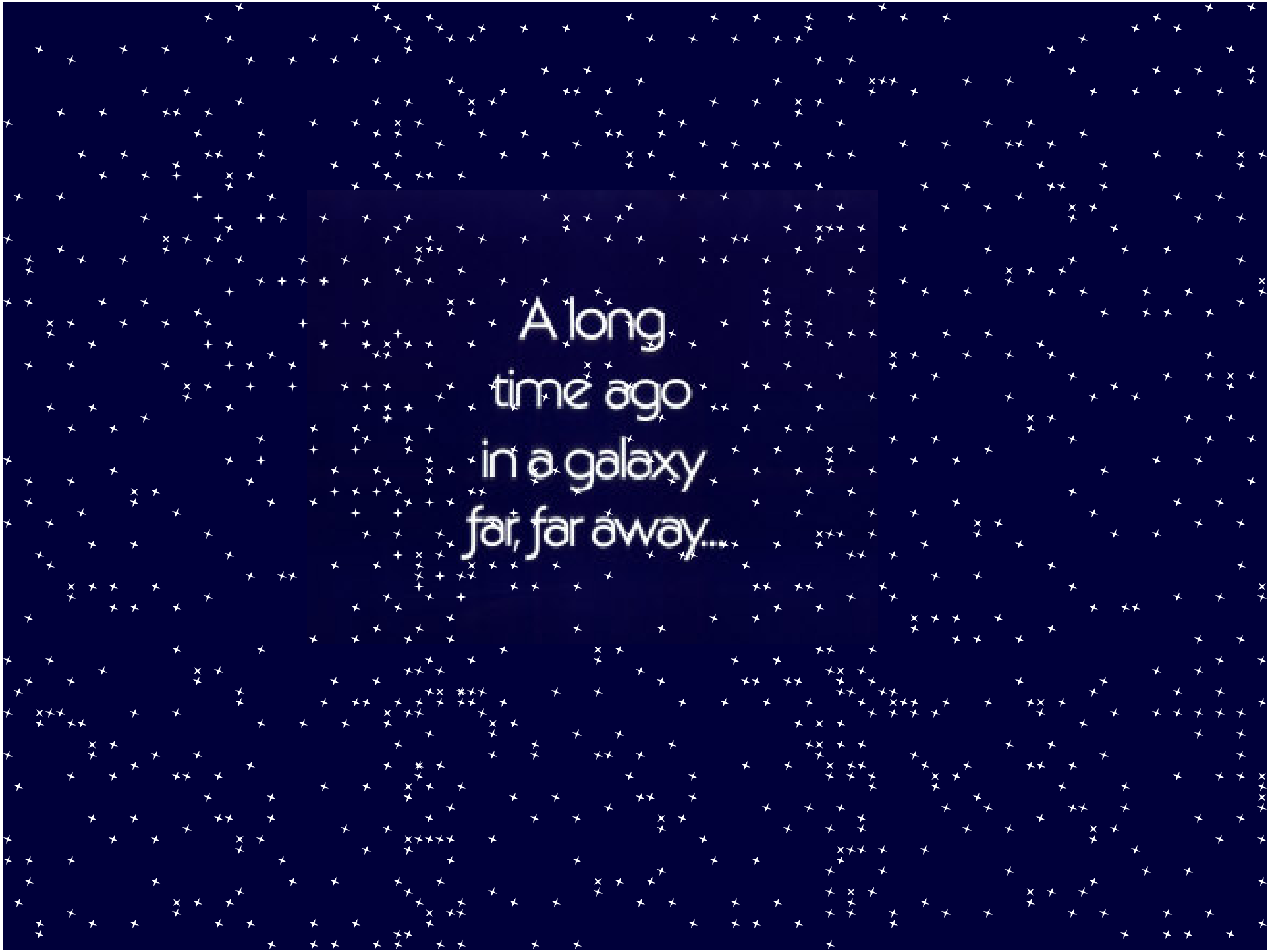

SECCHI (m)
UT FLOW (10**8 L)
ANNUAL AVERAGE SECCHI DEPTH and ANNUAL UPPER TRUCKEE RIVER FLOW
16
18
20
22
24
26
28
30
SECCHI (m)
10^4
1000
100
UT FLOW (10**8 L)
UC Davis Tahoe Environmental Research Center
1980
1985
1990
1995
2000
2005
YEAR

July 2006 Pathways Forum Received **“Preliminary”** Model Results



Today there are different results – based on “**Final**” Model Results


A long
time ago
in a galaxy
far, far away...

"Particles, particles, particles."